Annex 15b – Mechanical Ventilation Systems Installation (Non-domestic)

Annex 15B - Common Minimum Technical Competency Requirements for Mechanical Ventilation Systems Installation (Non-domestic)				
Routes to demonstrating required competence				
Route	**Qualifications/Certification**	**Experience / Evidence**	Inspection / Assessment	
			On –Site	Off-Site
1	Level 3 NVQ Diploma in Heating and Ventilating Ductwork Installation (QCF) **OR** SVQ Level 3 in Heating and Ventilating Ductwork Planning and Installation	Must have evidence of work carried out to be able to demonstrate their practical competence for the scope for which they have applied in accordance with the competence requirements stated in this annex.	Yes	No
2	**QCF Unit Achievement of units:** F/602/4909 - Understand and apply industrial and commercial rectangular ductwork installation and pre-commissioning techniques (Level 3); **and** A/602/4911 - Understand and apply industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques (Level 3); **and** H/502/8229 - Install and pre-commission industrial and commercial ductwork systems (Level 3) **OR** **SCQF Unit Achievement of units:** F9NE 04 - Install, Test and Pre-Commission Ductwork Systems and Components	Must have evidence of work carried out to be able to demonstrate their practical competence for the scope for which they have applied in accordance with the competence requirements stated in this annex.	Yes	No
3	Registered with a Building Regulations Competent Person Scheme or certificated by another a UKAS Accredited Certification Body for the type of work covered in this annex	Must have evidence of work carried out to be able to demonstrate their practical competence for the scope for which they have applied in accordance with the competence requirements stated in this annex.	Yes	No

4	Qualifications/certification other than above or no formal Qualification	Minimum of 3 years verifiable relevant experience covering the competence requirements stated in this annex and successful completion of the Experienced Worker Assessment	Yes	Yes

NOTES

Route 4 - Experienced Worker Assessments will be conducted by the registering Scheme Operator or Certification Body who shall assess the Enterprise's evidence of meeting the underpinning knowledge and practical competence requirements as stated in this annex. Note: Experienced worker assessment enable the competences within this annex to be assessed and demonstrated but do not lead to the award of a qualification.

Area of Competence	Mechanical ventilation systems installation (Non-domestic)		Annex 15B
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1 Know the working principles and layouts of rectangular, circular or flat oval industrial and commercial ductwork systems	Know the working principles for the following • Supply • Extract • Re-circulation • Kitchen extract • Low, medium and high pressure/velocity air		
	Know the working principles of the following components • Small air handling units • Fans, axial and centrifugal • Attenuator • Heater / filter / cooler batteries • Fan coil units • Variable air volume units • Regulating/ motorised dampers • Fire dampers • Kitchen hoods and grease filters • Plenum boxes • Access doors • Terminal units/Grilles/Diffusers		
	Know the operating and working principles for all of the following air handling units: • High and low velocity • Constant and variable volume systems: – Primary (fresh air) air plant for fan-coil, induction and room heat pump systems – Supply and extract air plant for single-duct, dual-duct and multi-zone systems – Special filtration for operating theatres, museums or clean rooms – Energy/ heat recovery for industrial application, and for very quiet applications such as concert halls. • Units that may be accommodated in plant rooms or external to the building served, typically a roof location. Including • Factors to determine unit/system selection • Key regulations relevant to the installation		

Area of Competence	Mechanical ventilation systems installation (Non-domestic)		Annex 15B
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1 Know the working principles and layouts of rectangular, circular or flat oval industrial and commercial ductwork systems (continued)	Know the procedures that should be followed where the installation requirements do not meet the design specification		
	Interpret the ductwork system layout requirements for systems and components including: – Systems • Supply • Extract • Re-circulation • Kitchen extract • Low, medium and high pressure/velocity air • Components • Rectangular ductwork components including flexible ducts • Air handling units • Fans, axial and centrifugal • Attenuator • Heater / filter / cooler batteries • Fan coil units • Variable air volume units • Regulating/ motorised dampers • Fire dampers • Kitchen hoods and grease filters • Plenum boxes • Access doors • Terminal units/Grilles/Diffusers In accordance with Industry specifications and regulations		
	Know the positioning of selected components in ductwork systems		
2 Know the legislative and organisational procedures related to rectangular, circular or flat oval industrial and commercial ductwork systems work activities	Know how to interpret and apply appropriate sources of health and safety information as they relate to the: • Installation • Testing • Commissioning		
	Know how to interpret and apply codes of practice and industry recommendations appropriate to the: • Installation • Testing • Commissioning		

Area of Competence	Mechanical ventilation systems installation (Non-domestic)		Annex 15B
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
2 Know the legislative and organisational procedures related to rectangular, circular or flat oval industrial and commercial ductwork systems work activities (continued)	Know how to prevent the inadvertent operation of the installed system during work activities		
3 Know how, and be able to complete preparation work for rectangular, circular or flat oval industrial and commercial ductwork installation	Know the visual inspections required in the work location to determine preparation requirements to: • Install • Test • Commission		
	Be able to confirm that job information and documentation for the installation of the following rectangular, circular or flat oval ductwork systems is available and appropriate, including: • Supply • Extract • Kitchen extract, as well as: • Medium and high pressure/velocity air systems Job information and documentation including: • Regulations • Industry Standards • Industry Guides/Good Practice Guides		
	Be able to confirm the points in the work process where liaison with other persons will be required		
	Be able to select and use job information and documentation to ensure that the following is fit for purpose: • Equipment • Tools		
	Know how to evaluate the work location to determine planning requirements		
	Know how to calculate from drawings and specifications the materials and fittings required to complete work on rectangular, circular or flat oval ductwork systems		
	Be able to demonstrate that suitable personal protective equipment has been worn throughout the duration of work preparation activities		

Area of Competence	Mechanical ventilation systems installation (Non-domestic)			Annex 15B
Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**
3	Know how, and be able to complete preparation work for rectangular, circular or flat oval industrial and commercial ductwork installation (continued)	Be able to identify any pre work damage or defects to existing equipment or building features should it exist, and report to the line manager		
		Be able to verify that the materials needed to complete the job are free from damage and report any defects		
		Be able to complete preparatory work for the installation of rectangular, circular or flat oval ductwork systems to include: • Completion of risk assessments • Completion of method statements		
4	Know the procedures, and be able to apply the procedures for identifying industrial and commercial rectangular, circular or flat oval ductwork systems, equipment and components	Know how, and be able to evaluate site drawings, plans and the work location to determine specific installation requirements on the following ductwork systems:		
		Know how, and be able to interpret and apply appropriate sources of information when determining installation requirements including: • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
		Know how to evaluate the installation requirements against drawings and specifications to determine compatibility		
		Know the range of environmentally friendly materials, products, procedures and energy efficiency devices		
5	Know how to install industrial and commercial rectangular, circular or flat oval ductwork systems	Be able to verify that job information appropriate to the installation process is available and conforms with industry specifications		
		Know the methodologies to measure and record site details for installation purposes		
		Be able to verify that materials, tools and equipment necessary for the installation are available as required • Safely and securely stored • Meet industry requirements • Fit for intended purpose		

Area of Competence		Mechanical ventilation systems installation (Non-domestic)		Annex 15B
Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**
5	Know how to install industrial and commercial rectangular, circular or flat oval ductwork systems (continued)	Know how, and be able to interpret and apply information from: • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
		Be able to verify that methods of working ensures that any damage to customer/client property and building features is avoided during work activities		
6	Know the procedures for the soundness testing of industrial and commercial rectangular, circular or flat oval ductwork systems	Know how, and be able to interpret and apply information for the soundness testing from: • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
		Know how, and be able to identify the requirements of circular or flat oval ductwork systems to confirm that they are ready to receive soundness tests to cover: • Ductwork • Appliances • Components		
		Be able to confirm through visual inspections that rectangular, circular or flat oval supply systems conform with industry specifications		
		Know how to interpret test records to confirm compliance with specifications		
		Know the actions that must be taken when testing reveals leakage f		
		Be able to complete and evaluate test sheet documentation in accordance with appropriate industry specifications/guides		
		Be able to implement checks to confirm: • System cleanliness • Un-commissioned systems and components cannot be activated		

Area of Competence	Mechanical ventilation systems installation (Non-domestic)		Annex 15B
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
7 Know the procedures for commissioning industrial and commercial rectangular, circular or flat oval ductwork systems	Know how, and be able to interpret and apply industry specifications and guidelines including: • Supply • Extract • Re-circulation • Kitchen extract • Low, medium and high pressure/velocity air		
	Specify the procedures for establishing correct mechanical and control performance for the following: • Small air handling units • Fans, axial and centrifugal • Heater / filter / cooler batteries • Fan coil units • Variable air volume units • Regulating/ motorised dampers • Fire dampers		
	Know the procedures for commissioning ductwork systems and components in accordance with industry specifications		
	Know, and be able to confirm the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required		
	Conduct mechanical and control performance checks and adjustments in accordance with industry specifications for the following: • Fans, axial and centrifugal • Heater / filter / cooler batteries • Regulating/ motorised dampers • Fire dampers		
	Know the information that would be required to complete commissioning documentation		
	Know the actions to take when components being commissioned do not meet performance requirements		

Annex 15B - Technical Reference Document Requirements

The Enterprise shall hold or have access to current editions, including all amendments, of the documents (or recognised equivalent documents) listed in the following table

Technical Reference Documents for Mechanical ventilation system installation (Non-Domestic)
Building Regulations - Approved Documents L2b(2010)
The Non-domestic Building Services Compliance Guide (2010)

Annex 15c – Air handling unit (Non-domestic)

Annex 15C - Common Minimum Technical Competency Requirements for air handling unit installation (non-domestic)				
Routes to demonstrating required competence				
Route	**Qualifications/Certification**	**Experience / Evidence**	Inspection / Assessment	
			On –Site	Off-Site
1	Level 3 NVQ Diploma in Heating and Ventilating Ductwork Installation (QCF) **OR** SVQ Level 3 in Heating and Ventilating Ductwork Planning and Installation	Must have evidence of work carried out to be able to demonstrate their practical competence for the scope for which they have applied in accordance with the competence requirements stated in this annex.	Yes	No
2	**QCF Unit Achievement of units:** D/602/4920 - Understand industrial and commercial air handling unit installation techniques (Level 3) **OR** **SCQF Unit Achievement of units:** F9NF 04 - Install, Test and Pre-Commission Air Handling and Extraction Units		Yes	No
3	Registered with a Building Regulations Competent Person Scheme or certificated by another a UKAS Accredited Certification Body for the type of work covered in this annex		Yes	No
4	Qualifications/certification other than above or no formal Qualification	Minimum of 3 years verifiable relevant experience covering the competence requirements stated in this annex and successful completion of the Experienced Worker Assessment	Yes	Yes

NOTES

Route 4 - Experienced Worker Assessments will be conducted by the registering Scheme Operator or Certification Body who shall assess the Enterprise's evidence of meeting the underpinning knowledge and practical competence requirements as stated in this annex. Note: Experienced worker assessment enable the competences within this annex to be assessed and demonstrated but do not lead to the award of a qualification.

Area of Competence	Air handling unit installation		Annex 15C
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1 Know the working principles and layouts of industrial and commercial air handling units	Know the operating and working principles for all of the following air handling units: • High and low velocity • Constant and variable volume systems: – Primary (fresh air) air plant for fan-coil, induction and room heat pump systems – Supply and extract air plant for single-duct, dual-duct and multi-zone systems – Special filtration for operating theatres, museums or clean rooms – Energy/ heat recovery for industrial application, and for very quiet applications such as concert halls. • Units that may be accommodated in plant rooms or external to the building served, typically a roof location. Including • Factors to determine unit/system selection • Key regulations relevant to the installation		
	Know the operating principles of different appliance types that are connected to air handling units, including: • Manufacturer's units • Compliance with industry specifications and manufacturer's instructions		
	Know the working principles of the following air handling unit components: • Mechanical, moving and non-moving parts • Electrical • Motors • Pumps • Humidifiers • Filters		

Area of Competence	Air handling unit installation		Annex 15C
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1 Know the working principles and layouts of industrial and commercial air handling units (continued)	Know how to calculate the duct sizing requirements for air handling units, including: • High and low velocity • Constant and variable volume systems: – Primary (fresh air) air plant for fan-coil, induction and room heat pump systems – Supply and extract air plant for single-duct, dual-duct and multi-zone systems – Special filtration for operating theatres, museums or clean rooms – Energy/ heat recovery for industrial application, and for very quiet applications such as concert halls. • Units that may be accommodated in plant rooms or external to the building served, typically a roof location		
	Confirm the air handling system layout requirements for: Systems • High and low velocity systems • Constant and variable volume systems: – Primary (fresh air) air plant for fan-coil, induction and room heat pump systems – Supply and extract air plant for single-duct, dual-duct and multi-zone systems – Special filtration for operating theatres, museums or clean rooms – Energy/ heat recovery for industrial application, and for very quiet applications such as concert halls. • Units that may be accommodated in plant rooms or external to the building served, typically a roof location. and components • Mechanical, moving and non-moving parts • Electrical • Motors • Pumps • Humidifiers • Filters In accordance with industry specifications and regulations.		
	Know the positioning of selected components in air handling units.		

Area of Competence	Air handling unit installation		Annex 15C
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
2 Know the legislative and organisational procedures related to all industrial and commercial air handling unit work activities	Know how to interpret and apply appropriate sources of health and safety information as they relate to the: • Installation • Testing • Commissioning of air handling units		
	Know how to interpret and apply codes of practice, and industry recommendations appropriate to the: • Installation • Testing • Commissioning of air handling units		
	Know how to prevent the inadvertent operation of the installed system during work activities		
3 Know how to complete preparation work for industrial and commercial air handling unit installation activities	Describe the visual inspections and tests required in the work location to determine preparation requirements to: • Install • Test • Commission On air handling units		
	Know how to evaluate the work location to determine planning requirements		
	Know how to calculate from drawings and specifications the materials fittings and components required to complete work on air handling units		
4 Know the procedures for identifying industrial and commercial air handling unit equipment and components	Know how to evaluate site drawings, plans and the work location to determine specific air handling unit installation requirements		
	Know how to interpret and apply appropriate sources of information when determining air handling installation requirements including: • Statutory Regulations • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
	Know how to evaluate the installation requirements against drawings and specifications to determine compatibility		

Area of Competence	Air handling unit installation		Annex 15C
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
4 Know the procedures for identifying industrial and commercial air handling unit equipment and components (continued)	Know the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to air handling units		
5 Know how to install industrial and commercial air handling units	Know the methodologies to measure and record site details for installation purposes		
	Know how to interpret and apply information for the installation of air handling units from: • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
6 Know the procedures for the testing of industrial and commercial air handling units	Know how to interpret and apply information for the testing of air handling units from: • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides • Specifications		
	Know the requirements of air handling units to confirm that they are ready to receive tests to cover: • Motors • Pumps • Humidifiers • Filters		
	Know the procedure for testing air handling units/unit components including: • Motors • Pumps • Humidifiers • Filters		
	Know the procedures for cleaning and charging an air handling unit		
	Know how to interpret test records to confirm compliance with specifications		

Area of Competence	Air handling unit installation		Annex 15C
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
7 Know the procedures for commissioning industrial and commercial air handling units	Know how to interpret and apply appropriate sources of information on the performance of air handling units including: • High and low velocity systems • Constant and variable volume systems: • Units that may be accommodated in plant rooms or external to the building served, typically a roof location.		
	Know the procedures for establishing correct mechanical and control performance for the following: Systems – • High and low velocity • Constant and variable volume systems: – Primary (fresh air) air plant for fan-coil, induction and room heat pump systems – Supply and extract air plant for single-duct, dual-duct and multi-zone systems – Special filtration for operating theatres, museums or clean rooms – Energy/ heat recovery for industrial application, and for very quiet applications such as concert halls. • Units that may be accommodated in plant rooms or external to the building served, typically a roof location. Components – • Mechanical, moving and non-moving parts • Electrical • Motors • Pumps • Humidifiers • Filters		
	Know the procedures for commissioning systems and components in accordance with industry specifications		
	Know the information that would be required to complete commissioning documentation		
	Know the actions to take when components being commissioned do not meet performance requirements		

Annex 15C - Technical Reference Document Requirements

The Enterprise shall hold or have access to current editions, including all amendments, of the documents (or recognised equivalent documents) listed in the following table

Technical Reference Documents for Air handling unit installation (Non-Domestic)
Building Regulations - Approved Documents L2b (2010)
The Non-domestic Building Services Compliance Guide (2010)

Annex 16a – Air conditioning installation

Annex 16A - Common Minimum Technical Competency Requirements for air conditioning system installation				
Routes to demonstrating required competence				
Route	**Qualifications/Certification**	**Experience / Evidence**	Inspection / Assessment	
			On –Site	Off-Site
1a	**600/0912/3** - City & Guilds Level 2 NVQ Diploma in Installing, Testing and Maintaining Air Conditioning and Heat Pump Systems (QCF)	Must have evidence of work carried out to be able to demonstrate their practical competence for the scope for which they have applied in accordance with the competence requirements stated in this annex.	Yes	No
1b	QCF unit achievement: **R/602/4994** - Understand and Carry Out Site Preparation and Pipework Fabrication Techniques for RAC Systems; and **A/602/496?** - Understand air conditioning and heat pump system installation, testing and maintenance techniques; and **K/602/4998** - Understand and carry out electrical work on RAC systems and components; and **Y/602/4981** - Understand and carry out brazing techniques for RAC systems; and **D/602/5002** - Install, Test and Maintain Air Conditioning and Heat Pump Systems		*Yes*	*No*
2	Alternative certification that has been mapped to the competence requirements within this Annex and agreed by SummitSkills as aligning with the competence requirements within this annex and aligning with the related requirements for acceptance as alternative certification		Yes	No
3	Registered with a Building Regulations Competent Person Scheme or certificated by another a UKAS Accredited Certification Body for the type of work covered in this annex		Yes	No

4	Qualifications other than above or no formal Qualification	Minimum of 3 years verifiable relevant experience covering the competence requirements stated in this annex and successful completion of the Experienced Worker Assessment*	Yes	Yes

NOTES

Route 4: Experienced Worker Assessments will be conducted by the registering Scheme Operator or Certification Body who shall assess the Enterprise's evidence of meeting the underpinning knowledge and practical competence requirements as stated in this annex. Note: Experienced worker assessment enables the competences within this annex to be assessed and demonstrated but do not lead to the award of a qualification.

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1. Know how to complete general site preparation work for RAC pipework systems	Know how to identify and use appropriate sources of information when preparing for RAC work activities, including: Regulations and standards • Statutory Regulations • Codes of Practice • Industry Standards • Industry Guides/Good Practice Guides Sources of information • Drawings, specifications and data • Common types of RAC drawing • Common graphical symbols and abbreviations used on RAC drawings • Specifications and standards used to communicate information • Service and maintenance records, programmes, schedules and specifications • Installation, Operating and Maintenance Manuals		
	Know what preparatory work is required for the work location in order to prepare, fit and fix, service and maintain and test then decommission RAC pipework systems, to include: • Preparing work sites • Identifying and selecting materials and equipment • Fit and fix cooling systems and components • Soundness testing systems and components • Commissioning systems and components		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
1 Know how to complete general site preparation work for RAC pipework systems (continued)	Know the building construction/local site features which may impact upon the work required to fit and fix, service and maintain and test then decommission RAC pipework systems, including: • Building construction methods and materials used in the RAC sector • Simple industrial/commercial building details • Main functions of the components that make up a simple building • Principal services required for a simple industrial/commercial building		
	Know the measures required to protect the building fabric/customer property, before and throughout completion of work on RAC installations, including: • Use of dust sheets • Protection from flame damage • Protection of customer/client • Protection of appliances and components before and during work activities		
	Know the implications that suspension of an RAC system can have on appropriate persons, including: • Customers • Other site workers • Site visitors		
2 Know how, and be able to apply leak tightness tests to RAC pipework	Know and be able to use the appropriate equipment for applying a leak tightness test to a pipework section		
	Know and be able to apply the procedure for completing a leak tightness test on a pipework section in accordance with appropriate industry standards and record the leak tightness test procedure		
	Know and be able to take the action that must be taken when inspection and testing reveals defects in RAC pipework, including: • Remedial work associated with leakage from RAC pipework systems		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
3 Know how, and be able to apply general site preparation techniques to fit, fix and test RAC pipework systems	Know the procedures for reporting problems that could delay progress of the work		
	Know the procedures for the ordering, requisitioning and checking of RAC materials		
	Know the procedures for the safe and secure storage of RAC materials, tools and equipment in the workplace		
	Be able to check the safety of the work location in order for the work to safely proceed • Safe access and exit • Immediate work location e.g. slips, trips and fall hazards • Appropriate risk assessments/ method statements are available and worked to		
	Be able to select Personal Protective Equipment relevant to the RAC work activity being carried out		
	Be able to select the hand and power tools relevant to the RAC work activity being carried out		
	Be able to check that tools and equipment selected for RAC work activity are safe to use and are correctly calibrated		
4 Know how, and be able to prepare to fit, fix and test RAC pipework systems	Know and be able to use the drawings and specifications required to prepare for the fabrication of RAC pipework systems		
	Know and be able to select the appropriate materials and fittings required to complete work and check them for damage, including: • Pipe • Copper • Steel pipe (for industrial refrigeration) • Insulation • Plastic or copper condensate pipe work • Fittings • Flare nut fittings (implications of use – i.e. possibility of leakage) • Line tap and Schrader valves • Mechanical control devices • Electrical control components • Brazed fittings • Steel pipe fittings (for industrial refrigeration) • Electrical cables and associated component fittings		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
4 Know how, and be able to prepare to fit, fix and test RAC pipework systems (continued)	Know and be able to select the hand and power tools required to complete work, including: Tools for - • Marking out • Cutting (pipe, cable & insulation) • Bending (copper pipe & plastic conduit) • Jointing (Electrical, Mechanical and Brazing) Specialist tools used in the RAC sector - • Brazing equipment • Torque wrenches • Electric drills (110v and cordless) • Electrical test instruments • Pipe bending machines • Pipe cutters and Reamers • General hand tools • Levels (including Laser) • Core drills • Joint forming tools (Swage, brazing etc) • Relevant Mechanical and Electrical testing equipment		
	Know and be able to select the Personal Protective Equipment relevant to the work activity		

5 Know how, and be able to fabricate RAC pipework	Know the methods and techniques for fabricating, and be able to fabricate RAC pipework to industry standards and specifications including:
	• Measuring and marking out
	• Bending; hand springs and mechanical formers -
	  ○ 90°
	  ○ Off-set
	  ○ Passover
	• Cutting
	• Drilling and fixing		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**

5 Know how, and be able to fabricate RAC pipework (continued)	Know the material jointing techniques, and conduct jointing on pipework using:
	• Mechanical methods
	  ○ Flare joints
	• Heat methods
	  ○ Flame Brazing and Gas Welding
	  ○ Silver soldering
	• Solvent methods
	  ○ Adhesives for insulation
	• Joints for secondary refrigeration systems (glycol)		

	Know the methods and techniques for using, and be able to select and use hand tools, power tools, drills and fixing devices for fixing to: • Wood (timber studding and wall board) • Masonry (brick, block, concrete, plasterboard) • Metal And using appropriate fixing devices, including: • Nails • Screws • Heavy duty fixing devices • Threaded rod and 'U' channel		
	Know the methods and techniques for fixing pipework, and be able to fix pipework using clips and brackets for the following pipe materials as identified in • Copper • Steel • Insulation • Plastic / copper condensate pipe work		
	Know how to determine the appropriate bracket spacing intervals in accordance with pipe diameter requirements for horizontally and vertically mounted copper pipework		

Area of Competence	Air conditioning system installation		Annex 16A

Competence requirement The installer must:		Context/Scope	NOS Ref.	Further Guidance
5	Know how, and be able to fabricate RAC pipework (continued)	Know and be able to apply the industry requirements for: • Safe use of tools identified in for - o Marking out o Cutting o Bending o Jointing (Mechanical and Brazing) • Tool maintenance o Cleaning o Servicing o PAT testing (confirmation of due date) o Sharpening o Calibration (confirmation of due date)		
6	Know the specific Health and Safety requirements which apply to the fitting and fixing, servicing and maintaining and de-commissioning of air conditioning and heat pump systems	Know the COSHH requirements of different refrigerants and other pressurised and flammable fluids		
		Know the impact that working with refrigerants can have on the safety of individuals and wider environment		
		Know the dangers associated with pressurised systems		
7	Know the legislative and organisational procedures for fitting and fixing, servicing and maintaining and de-commissioning of air conditioning and heat pump systems	Know the appropriate sources of health and safety information when fitting and fixing, servicing and maintaining and de-commissioning of air conditioning systems		
		Know the regulations, codes of practice, and industry recommendations appropriate to the fitting and fixing of air conditioning systems, including working with refrigerants and other pressurised and flammable fluids		
		Know the appropriate persons whom it may be necessary to advise before a system is isolated in order to undertake work		
		Know the actions that should be taken to liaise with other persons upon completion of work procedures with regard to: • Safe system shutdown • Labelling of components • Recording refrigerant and oil use		

Area of Competence		Air conditioning system installation		Annex 16A
Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**

8	Understand the working principles and layouts of air conditioning and heat pump systems	Know the function and operating principles of:
		• Compressors
		• Condensers
		• Expansion devices
		  o Capillary tube
		  o Thermostatic expansion valves
		  o Electronic expansion valves
		• Direct Expansion and Flooded Evaporators
		• Accumulators
		• Air to air cooling only systems (aero thermal)
		• Air to water heat pump systems (hydrothermal)		

		Know the features and characteristics of: • Oil free compressors • Four way valves • Critical charge systems • Inverter driven systems (2 and 3 pipe systems) • Low ambient control systems • Pipework insulation • Air filters • Condensate removal		
		Know the properties, advantages and disadvantages of different refrigerants, including: • Leakage implications (direct and indirect) • TEWI (Total Environmental Warming Impact) effect		
		Know how the following are designed or contribute towards helping to reduce the indirect Global Warming Potential of RAC systems: • Variable speed drives • Defrost controls • Capacity control • Enhanced Capital Allowances (ECAs) • Energy Efficiency Ratio (EER)		
		Know the requirements for following work procedures to replace refrigerant types in RAC systems		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
8 Understand the working principles and layouts of air conditioning and heat pump systems (continued)	Know the procedures for plotting the following on a simple psychometric chart: • Sensible heating • Sensible cooling • Humidification • Dehumidification		
	Know how to identify and calculate cooling and heating capacity in kW using system information and psychometric charts		
	Know the various environmental conditions in relation to the operation of air conditioning and heat pump systems		
9 Know the procedures for fitting, fixing and testing cooling systems equipment and components	Know the fitting and fixing procedures for air conditioning and heat pump systems, equipment and components, to include: • Indoor refrigeration units • Fresh and regenerated air systems • Outdoor refrigeration units • Water Chillers		
	Know the suitable methods for making pipework connections to: • Single and multiple Indoor units • Outdoor units		
	Know the requirements for the correct selection and use of the following items of specialist RAC equipment: • Gauges and regulators • Leak detection devices • Vacuum pumps • Weighing scales		
	Know the methods and procedures for: • Strength integrity testing • Tightness testing • Leak testing • Evacuation and dehydration		
	Know the requirements for the appropriate test results		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
9 Know the procedures for fitting, fixing and testing cooling systems equipment and components (continued)	Know the procedures for charging blended (zeotopic blends) and single fluid refrigerants into systems		
	Know the procedures for determining when charge is correct in air to air and air to water refrigeration systems		
	Know the process for handing over systems to customers, including: • Operation of system and controls		
	Know the procedures for completing appropriate employer and any required legislative documentation when work is complete		
10 Know the electrical standards that apply to the mechanical services industry	Know the statutory legislation and guidance information that applies to electrical supply and control of domestic mechanical services systems and their components • General legislation • Construction specific legislation • Mechanical services specific legislation – Professional body guidance • Codes of practice • Manufacturer installation & service/maintenance instructions • Manufacturer user instructions		
	Know the range of information that would be detailed on a minor works certificate for an electrical system or component		
	Know the procedure for notifying works carried out to the relevant authority		
11 Know the principles of electricity supply to Buildings	Know the methods by which electricity is generated • Basic power station operation • Principles of generation • Types of supply - Single phase - Three-phase and neutral		

Area of Competence	Air conditioning system installation (		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
11 Know the principles of electricity supply to Buildings (continued)	Know the methods by which generated electricity is distributed to non dwellings and commercial properties. • Basic operation of the national grid and local distribution systems - Sub-stations - Supply transformers - Local distribution of three – and single-phase supplies to premises		
	Know the purpose of electrical components at entry to the property • Main fuse (single phase) and cable head connection • Meter • Consumer unit • Main earth terminal		
12 Know the layout features of electrical circuits in Buildings	Know the system layout features for electrical circuits in non dwellings and commercial properties • Ring main circuit • Radial circuit • Fixed equipment supplies - Spurs and fused outlets		
	Know the types of cables and conductors used for the installation of electrical equipment in mechanical services systems		
	Know the applications and limitations of the types of cable and conductors used for the installation of electrical equipment in mechanical services systems		
	Know the difference between class 1 and class 2 electrical equipment		

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Competence requirement The installer must:		Context/Scope	NOS Ref.	Further Guidance

12	Know the layout features of electrical circuits in Buildings (continued)	Know the function of electrically operated components used in mechanical services systems
		• Flame rectification devices
		• Flame suppression devices
		• Solenoid valves
		• Thermistors
		• Thermocouples
		• Micro switches
		• Relays
		• Printed circuit boards
		• Pressure switches
		• Pumps
		• Fans
		• Compressors
		• Evaporators
		• Leak detection
		  • Control components
		• Thermostats
		• Programmers/timers
		• Electrically operated control valves
		• Wiring centres
		  • Switches
		• Rocker plate (with/without cpc) – single and double pole
		• Pull cord
		• Pressure operated		

		Know the operating principles of electrical circuit protection devices
		• Miniature circuit breakers
		• Residual current devices including RCBOs
		• Fuses
		  - Re-wireable
		  - Cartridge
		  - High breaking capacity		

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Competence requirement The installer must:		Context/Scope	NOS Ref.	Further Guidance
12	Know the layout features of electrical circuits in Buildings (continued)	Know the need for, and requirements of earthing systems • Main earthing systems - TT system - TN - S system - TN-C-S system • Protective equipotential bonding • High risk rooms (zones) in dwellings • Supplementary earthing (bonding) • Temporary continuity bonding		
		Know the warning notices to be applied		
13	Know, and be able to carry out the electrical industry safe isolation procedure	Know and be able to use the test equipment required to prove that circuits to be worked on are dead • Approved voltage indicating device • Proving unit		
		Know and be able to carry out the electrical industry agreed procedure for safe isolation of electrical circuits • Select the approved voltage indicating device and test on a known supply • Locate and identify the isolation point for the equipment to be worked on • Isolate the supply and prevent re-energisation • Verify that the equipment is dead • Fit warning labels • Re-check the approved voltage indicating on a known supply for correct function		
		Know the methods of ensuring that circuits cannot be re-activated while work is taking place on them • Use of locking devices • Device retention (fuse removal)		
14	Know, and be able to demonstrate and apply the site preparation techniques for the electrical connection of mechanical services components	Know the required sources of information when carrying out work on electrical systems • Statutory regulations • Industry standards • Manufacturer technical instructions		

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Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**
14	Know, and be able to demonstrate and apply the site preparation techniques for the electrical connection of mechanical services components (continued)	Be able to check the safety of the work location in order for the work to safely proceed • Safe access and exit • Immediate work location e.g. tripping hazards • Appropriate risk assessments/ method statements are followed		
		Know the preparatory work required to be carried out to the building fabric in order to install or commission electrical systems or components		
		Know the types of pre-existing damage to the existing building fabric or customer property that may be encountered before commencing work on electrical systems and components • Building wall/floor surfaces • Existing electrical system components • Building décor and carpets		
		Know the protection measures to be applied to the building fabric or customer property, during and on completion of work on electrical systems and components • Building wall/floor surfaces • Existing and new electrical systems and kitchen furniture / components and hygiene • Building décor and carpets		
		Know the cable, materials and fittings required to complete work on electrical systems		
		Know the hand and power tools required to complete work on electrical systems		
15	Know the installation and connection requirements of, and be able to install electrically operated mechanical services components	Know the method used to identify that existing electrical supplies and circuits are suitable for the proposed installation of electrical equipment used in domestic mechanical services systems		
		Know the procedure for sizing electrical materials and components • Basic cable sizing procedure type cables and conductors • Basic circuit protection device sizing procedure –circuit types		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
15 Know the installation and connection requirements of, and be able to install electrically operated mechanical services components (continued)	Know the method used to select suitable cables and cords for components and circuits • Selection of appropriate multi-core cables • Selection of appropriate multi-core cords • Selection of pvc single conductors		
	Know the requirements for protecting cables installed in the building fabric and terminating in enclosures • Protection methods in wall and floor surfaces - Embedded (sheathing) – depth of cover, application of RCD protection - Exposed (mini-trunking) - Within ducting - Within timber stud partitions - Within timber floor structures • Junction boxes • Switch/socket boxes - Countersunk - Pattresses - Surface mounted • Wiring centres		
	Know the types of cable termination methods approved for use in dwellings • Screw terminals • Pillar terminals • Claw and washer terminals • Crimping • Strip connectors		
	Be able to carry out the electrical wiring of a mechanical / refrigeration or air conditioning control system from an existing supply. • Refrigeration or air conditioning system incorporating all necessary control components • Positioning and fixing of all necessary enclosures, switches and circuit protection devices • Correct routing, installation and termination of appropriate cables and conductors to control system components • Correct earthing provision for all components and exposed metallic parts of the system		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
15 Know the installation and connection requirements of, and be able to install electrically operated mechanical services components (continued)	Know the method of installation and wiring termination for fixed electrical equipment • From consumer unit - Air Conditioning Units cassette / free standing - Free standing chiller / cooler - Refrigeration cabinet - Refrigeration control unit - Refrigeration compressor / pack - Refrigeration evaporators • From fused-spur connection unit - Air Conditioning Units cassette / free standing - Free standing chiller / cooler - Refrigeration cabinet - Refrigeration control unit - Refrigeration compressor / pack - Refrigeration evaporators • From existing appliance supply point - Air Conditioning Units cassette / free standing - Free standing chiller / cooler - Refrigeration cabinet - Refrigeration control unit - Refrigeration compressor / pack - Refrigeration evaporators		
	Be able to apply temporary continuity bonding to metallic pipework prior to making pipework connections		
16 Know the inspection and testing requirements of, and be able to inspect and test, electrically operated mechanical services components	Know the requirements of a visual inspection of completed electrical installation work for mechanical services systems prior to electrical inspection and testing		
	Know the equipment used for electrical testing of mechanical services components and its calibration requirements		
	Know the importance of carrying out tests on dead circuits wherever possible		

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Competence requirement The installer must:		Context/Scope	NOS Ref.	Further Guidance
16	Know the inspection and testing requirements of, and be able to inspect and test, electrically operated mechanical services components (continued)	Know the purpose of the electrical testing procedures for new and existing circuits • Polarity • Earth continuity • Insulation resistance • Earth fault loop impedance • Residual current device		
		Know the requirements for carrying out functional testing of electrical components		

		Be able to carry out the inspection and testing of a completed refrigeration or air conditioning controls system
		• Visual inspection
		• Selection and use of appropriate test equipment
		• Appropriate circuit testing
		  - Polarity
		  - Earth continuity
		  - Insulation resistance
		• Functional testing
		• Completion of a minor works certificate		

		Be able to carry out the inspection and testing of existing electrical circuits following replacement of electrical conductors, to: • refrigeration or air conditioning systems and/ or equipment components		
		Know the procedure for final handover of electrical circuits that supply electrically operated domestic mechanical services components • Installation completion of certification • Demonstration to the user		
17	Know the procedures for safely diagnosing and rectifying faults, and be able to diagnose and rectify faults in electrically operated mechanical services components	Know the methods of obtaining details of system faults from end users		

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Competence requirement The installer must:		Context/Scope	NOS Ref.	Further Guidance
17	Know the procedures for safely diagnosing and rectifying faults, and be able to diagnose and rectify/faults in electrically operated mechanical services components (continued)	Know how to identify and use manufacturer instructions and industry standards to establish the diagnostic requirements of electrical system components		
		Know the electrical test equipment used to undertake fault diagnostics		
		Know the situations in which dead testing of components can be carried out		
		Be able to safely isolate electrical systems or components to prevent them being brought into operation before the work has been fully completed		
		Know the situations in which live testing of components may be necessary and the safety precautions required		
		Know how to perform a range of routine checks and diagnostics on electrical system components as part of a fault finding process. Checking for correct operation of • Appliance components - Flame rectification devices - Flame suppression devices - Solenoid valves - Thermistors - Thermocouples - Micro switches - Relays - Pressure switches - Printed circuit boards - Pumps - Fans - Compressors - Evaporators - Leak detection • Control components - Thermostats - Programmers/timers - Electrically operated control valves - Wiring centres • Switches - Rocker plate (with/without cpc) - single and double pole Pull cord - Pressure operated		

Area of Competence	Air conditioning system installation		Annex 16A
Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
17 Know the procedures for safely diagnosing and rectifying faults, and be able to diagnose and rectify/faults in electrically operated mechanical services components (continued)	Know the methods of correcting deficiencies in electrical components • Inadequate earthing provision • Defective cable positioning (aged cables/ proximity to other services) • Failed electrical components • Incorrect polarity • Provision of inadequate circuit protection devices		
	Be able to carry out diagnostic checks to electrical circuits • Inadequate earthing provision • Defective cable routing • Defective termination • Incorrect polarity • Provision of inadequate circuit protection devices		
	Be able to carry out diagnostic tests to locate faults in electrical components and carry out repair work • Refrigeration components replacement • Air conditioning components replacement • Control components - Thermostats - Programmers/timers		
18 Know the working principles of RAC compressed gas brazing processes	Know the working principles of all the following items of compressed gas brazing equipment: • Compressed gas cylinders • Two stage regulators • Blowback arresters • Non-return valves • High pressure welding torches • Welding nozzles • High pressure hoses		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
19 Know the legislative and organisational procedures related to RAC compressed gas brazing processes	Know how to Interpret and apply appropriate sources of health and safety information as it relates to: • Compressed gases • Welding equipment • Brazing processes • Materials handling		
	Interpret and apply regulations, codes of practice, industry recommendations, and brazing specifications appropriate to: • Compressed gases • Welding equipment • Brazing processes		
	Know the appropriate persons whom it may be necessary to advise before undertaking brazing processes		
	Know the actions that should be taken upon completion of brazing processes in terms of: • Quality control • Documentation procedures		
	Know how to prevent the inadvertent operation of brazing equipment after completion of work operations		
20 Know how, and be able to complete preparation work for compressed gas brazing activities	Know how, and be able to carry out a basic risk assessment for the completion of brazing in the work location		
	Know and be able to Interpret the method statements for brazing to ascertain requirements for: • Storage of materials and finished products • Availability of service supplies • Informing appropriate people at key stages in the brazing process • Reporting problems • Joining procedures • Job instructions		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
20 Know how, and be able to complete preparation work fo compressed gas brazing activities (continued)	Know and be able to select the Personal Protective Equipment appropriate to the work activity being carried out		
	Know the preparation requirements for: • Joining pipework by brazing • Testing brazed pipework sections • Commissioning brazed pipework sections		
	Know and be able to select the pipework materials and fittings required to complete brazing processes and check them for defects		
	Know and be able to select the suitable tools and equipment required to carry out brazing processes		
	Know the procedures for maintaining brazing tools and equipment		
21 Know how, and be able to connect pipework by compressed gas brazing	Know how to identify and interpret engineering drawings and brazing specifications for the completion of brazing procedures		
	Know the methods for and be able to set up and use brazing equipment, including: • Compressed gas cylinders • Two stage regulators • Blowback arresters • Non-return valves • High pressure welding torches • Welding nozzles • High pressure hoses		
	Know the basic principles for inspecting, testing and maintaining gas brazing equipment		
	Know the procedures for and be able to braze the following materials in accordance with industry standards: • Copper pipe • End feed bends and elbows • End feed tees • End feed couplings • Integral ring capillary fittings • Manually formed sockets • Manually formed branches		

Area of Competence		Air conditioning system installation		Annex 16A
Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**
21	Know how, and be able to connect pipework by compressed gas brazing (continued)	Know the procedures for and be able to conduct: • Checks on brazed joints for compliance • Tests for defects		
		Be able to complete checks to establish that: • Joint preparation • Brazing equipment • Consumables comply with specifications and are fit for purpose		
		Be able to select tools and equipment required to carry out compressed gas brazing of pipework and confirm they are fit for purpose		
		Be able to confirm that equipment has been safely isolated after completion of brazing activities		
		Be able to complete relevant documentation including brazed joint test reports		
22	Be able to plan and prepare for the installation, testing and maintenance of air conditioning systems	Be able to confirm that all information is available prior to planning installation or maintenance activities		
		Be able to confirm that all tools, equipment and materials are available and fit for use prior to commencement of the work		
		Be able to confirm that all persons relevant to the installation or maintenance activity are identified and that lines of communication are established		
		Be able to ensure that all necessary risk assessment and safe working procedure development has been undertaken prior to work commencement		
		Be able to carry out site survey to identify any variations or deviations to planned work or any structural or access issues which need to be resolved prior to work commencement		
		Be able to identify safe storage arrangements for tools, equipment and materials prior to commencement of installation or maintenance activity		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
22 Be able to plan and prepare for the installation, testing and maintenance of air conditioning systems (continued)	Be able to plan safe access to work areas and confirm with responsible person on site		
	Be able to complete preparatory work as necessary in relation to: • The location, siting and fixing of: - Outdoor unit/condensers - Indoor unit/evaporators - Piping (flow and return) • Jointing by brazing or flaring • Confirming requirements for: - Cleanliness inside pipes by purging with OFN - Insulation - Electrical connection - Condensate disposal		
23 Be able to carry out the installation of air conditioning systems	Be able to identify and interpret appropriate sources of information which impact upon the installation of air conditioning pipework, systems and components, including: • Regulatory documents • Industry Codes of Practice • Manufacturer's instructions • Installation specifications		
	Be assemble air conditioning system components to meet the requirements of the installation specification		
	Be able to demonstrate appropriate methods for positioning and fixing: • Indoor units • Outdoor units • Condensate drains		
	Be able to demonstrate appropriate methods for interconnecting, fixing and insulating pipework		

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Competence requirement The installer must:	**Context/Scope**	**NOS Ref.**	**Further Guidance**
23 Be able to carry out the installation of air conditioning systems (continued)	Be able to complete the interconnection and fixing of electrical power and communication components		
	Be able to confirm that installed system components and pipework are correctly installed in accordance with the installation specification		
	Be able to confirm that the worksite has been cleared in preparation for system testing		
24 Be able to carry out the testing of air conditioning and heat pump systems	Be able to carry out the checks and tests in accordance with industry and safety requirements		
	Be able to carry out the following tests in accordance with appropriate legislation: • Strength integrity test • Pressure tightness test • Leak test • Evacuation, dehydration and vacuum rise test		
	Be able to compare pipework length with system factory charge and determine whether extra refrigerant charge is required		
	Be able to add additional refrigerant charge by weight in accordance with manufacturer's instructions		
	Be able to carry out basic electrical tests to confirm that system is safe to switch on: • Continuity • Insulation resistance • Polarity • Resistance to earth • Visual check		
	Be able to open system valves and run system		
	Be able to complete checks to confirm system is leak free		
	Be able to confirm that the system provides cooling and/or heating by measuring air flow temperature difference across indoor and outdoor unit heat exchangers		

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Competence requirement The installer must:		**Context/Scope**	**NOS Ref.**	**Further Guidance**
24	Be able to carry out the testing of air conditioning and heat pump systems (continued)	Be able to record temperature differences		
		Be able to remove analysers/gauges from systems without refrigerant loss		
		Be able to replace valve caps and confirm valves are leak free		

Annex 16A - Technical Reference Document Requirements

The Enterprise shall hold or have access to current editions, including all amendments, of the documents (or recognised equivalent documents) listed in the following table

Technical Reference Documents for Air conditioning systems installation
Building Regulations - Approved Documents L1b, L2b (2010)
The Non-domestic Building Services Compliance Guide (2010)
The Domestic Building Services Compliance Guide (2010)
BSRIA Model Commissioning Plan (BG 8/2009)